

# Technology Opportunity

## Printed Circuit Antenna Design, Fabrication, and Metrology

The National Aeronautics and Space Administration (NASA) Lewis Research Center will participate as appropriate in selected collaborative efforts with regional industries interested in developing microwave and millimeter-wave antennas—especially printed-circuit or flat-panel types—for communications, radar, or sensing applications.

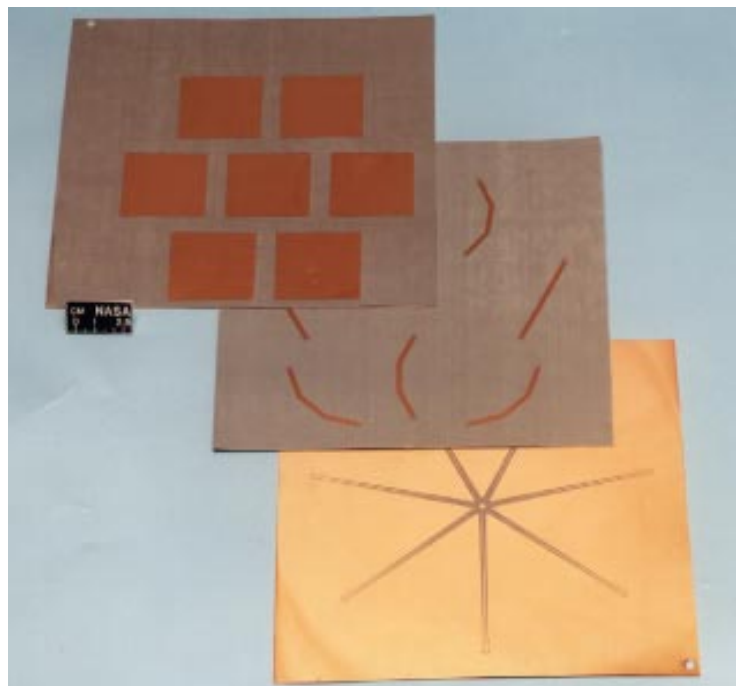
### Potential Commercial Uses

- Earth terminals
- Automatic cruise control and collision avoidance
- Personal communications systems
- Wireless Local Area Networks (LAN)

- Direct broadcast service
- Automatic tolling
- Remote sensing
- Navigation

### Benefits

- Reduced manufacturing cost
- Low, flat profile
- Easily transportable
- Aesthetically pleasing
- Potential for integration with active components



A seven-patch, hexagonal, circularly polarized subarray with a coplanar waveguide/stripline feed network.



National Aeronautics and  
Space Administration  
Lewis Research Center

## The Technology

Few discoveries have proven to be so important to the prosperity of modern society as electromagnetic waves, which were predicted by James Clerk Maxwell and confirmed by Heinrich Hertz more than a century ago. Antennas are the generators and receivers of these electromagnetic waves, converting electrons to photons or vice versa, thereby forming a smooth transition between electronic circuitry and free space.

Most of the fundamental types of antennas are nearly as old as the discovery of electromagnetic radiation. However, better electromagnetic models and computational methods as well as the development of high-quality substrates have ushered in a new class of printed-circuit antennas. Complemented by state-of-the-art submicrometer device processing and a trend toward higher operating frequencies, these high-performance, cost-effective printed-circuit antennas are becoming an attractive option for many wireless applications.

NASA Lewis has made significant contributions to printed-circuit antenna technology. Numerous edge-coupled, aperture-coupled, and probe-fed designs have been fabricated and tested, and prototype flat-panel arrays have been constructed and evaluated, especially at frequencies around 20 and 30 GHz. Lewis has substantial design, simulation, fabrication, and characterization capabilities for these printed-circuit antennas. In addition, Lewis' Microwave Systems Laboratory features a small far-field antenna range, a near-field antenna range, and a compact antenna range that can characterize both transmit and receive antennas operating at frequencies ranging from 750 MHz to 40 GHz:

- The far-field facility is a semi-automated, anechoic chamber that can measure phases and amplitudes from 750 MHz to 40 GHz, with a 25-ft testing range and a 60-dB dynamic range.
- The near-field facility is a fully automated, anechoic chamber with a 20- by 20-ft scan plane that is flat to within 0.005 in. root mean square. In addition to its 2- to 40-GHz frequency range and 60-dB dynamic range, on-site data reduction and display are available.

- The compact range facility also is a fully automated, anechoic chamber and has a quiet zone 3 ft in diameter and 6-ft deep. This facility, which has an impressive 100-dB dynamic range, can characterize antennas from 2 to 36 GHz. Again, on-site data reduction and display are available.

## Options for Commercialization

Flat-panel, printed-circuit antennas are believed to be a promising technology for many applications, such as those noted previously. Embedded in Lewis' mission, and specific to the charter of the Space Communications Division, is a strong commitment to commercialize communications technology. To this end, Lewis will meet with interested parties on a case-by-case basis to explore possibilities for cooperative efforts in designing, fabricating, and/or testing microwave antennas for communications and other applications.

Any company desiring assistance in the development of such antennas or the evaluation of antenna performance is encouraged to contact NASA Lewis. Collaborative partnership will be considered and selected on the basis of

- Appropriateness for government
- Benefit to proposer
- Level of effort required
- Availability of resources

## Contact

Dr. Charles A. Raquet, Chief  
Antenna and RF Systems Technology Branch  
NASA Lewis Research Center  
Mail Stop 54-8  
21000 Brookpark Road  
Cleveland, OH 44135  
Phone: (216) 433-3471  
Fax: (216) 433-8705  
E-mail: c.raquet@lerc.nasa.gov

## Key Words

Antenna  
Patch antenna  
Flat panel array  
Microwave radiation  
Phased-array antenna



National Aeronautics and  
Space Administration  
Lewis Research Center